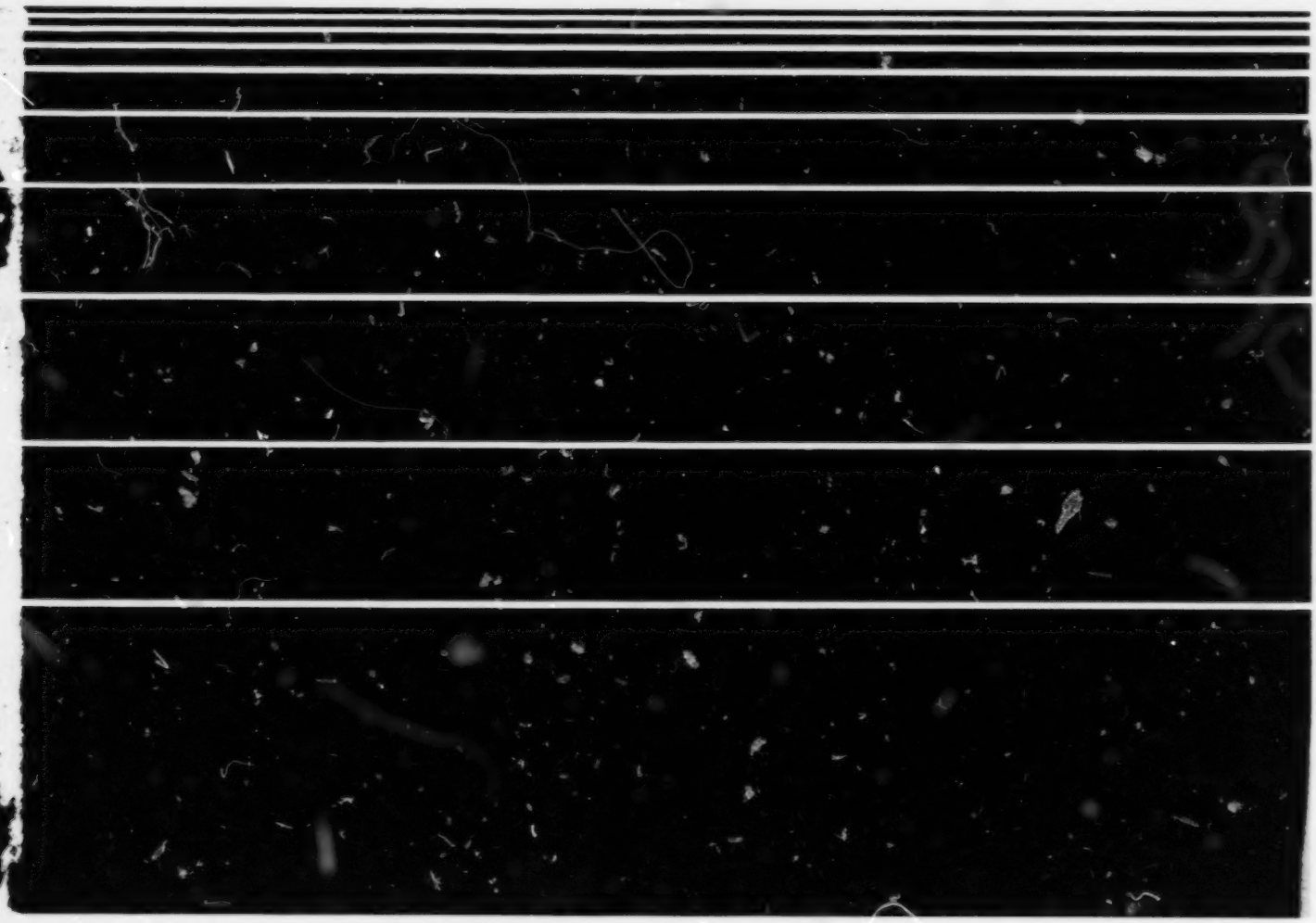

Manitoba
Environment
and Workplace
Safety and Health

MG–8159

Sulphur Dioxide Monitoring in the Vicinity of the Canada Metal Co. Ltd. 1986

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Air Standards and Studies Section
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Air Standards and Studies
Report 87-1

Bennett, M and Mark Szkolnicki, 1986. Sulphur Dioxide Monitoring in the Vicinity of the Canada Metal Co. Ltd. 1986. Manitoba Department of Environment and Workplace Safety and Health, Air Standards and Studies Report No. 87-1 pp.30.

Abstract

At the request of Environment Canada's Environmental Protection Service, monitoring was conducted in the vicinity of Canada Metal Co. Ltd., 1221 St. James Street, for three days during January 1986. Results of this monitoring indicated the source of odourous emissions responsible for public complaints was the above named company. While hourly measured levels of sulphur dioxide (SO_2) did not exceed the Maximum Acceptable Level of 0.34 ppm, elevated concentrations were noted and in several instances (3 hours) the Maximum Desirable Level of 0.17 ppm was exceeded.

Dispersion modelling results suggest that maximum ground level concentrations of SO_2 occured at a location downwind of the chosen monitoring site(s). The same dispersion estimate revealed that the maximum predicted concentration at this location was almost 3 times greater than the MAL. On the basis of visual observation and model predictions it seems that levels in excess of objectives did occur during the period of complaints.

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2. BACKGROUND

Canada Metal Co. Ltd. is a secondary lead smelter located at 1221 St. James St. in Winnipeg. On January 20th, 1986 both the Provincial and Federal Departments of Environment started receiving public complaint calls reporting unpleasant sulphurous odours. At the request of Environment Canada (Environmental Protection Service) the Mobile Monitoring Unit (MMU) was mobilized in order to investigate the cause of the complaints. This request was made on the afternoon of the 21st and preparations for response were commenced.

A preliminary survey using a hand held sulphur dioxide (SO_2) analyzer was conducted on the afternoon of the 21st. The MMU was taken out on the 22nd. Further monitoring was conducted on the 23rd and 24th.

The objectives of the survey were:

1) Attempt to pin-point the source of emissions responsible for the complaints,
2) Quantify the ambient SO_2 levels and,
3) Compare these concentrations to the Manitoba Air Quality Objective (MAQO) for SO_2,
4) Use a dispersion model to a) provide an assessment of our selected monitoring sites with respect to an ideal location (ie. a location which would experience the highest predicted concentration according to the model) and, b) derive an estimate of emission rates based on the results of actual monitoring from the sites selected.

A previous study was conducted in April of 1984[1], also in response to odour complaints. The results indicated that, at the monitored receptor sites and during the period of investigation, sulphur dioxide levels in the area of Canada Metal Co. Ltd. did not exceed the maximum acceptable level of 0.34 ppm averaged over one hour. The maximum desirable level of 0.17 ppm (1 hour) was exceeded in some cases. It was concluded that, under certain meteorological conditions, the Manitoba Air Quality Objectives for sulphur dioxide could have been exceeded.

3. MANITOBA AIR QUALITY OBJECTIVES

Manitoba Air Quality Objectives and Guidelines have been formulated for various air pollutants. The objectives for sulphur dioxide (see Table 1) have been adopted from the National Air Quality Objectives.

The provincial criteria have been established for three levels:

Maximum Tolerable Level (MTL) - This level denotes a time-based concentration of air contaminant beyond which, due to a diminishing margin of safety, appropriate action is required to protect the health of the general population.

Maximum Acceptable Level (MAL) - This level is intended to provide adequate protection against effects on soil, water, vegetation, materials, animals, visibility, personal comfort and well being.

Maximum Desirable Level (MDL) - This level defines long term goals for air quality and provides a basis for anti-degradation policy for the unpolluted parts of the province for the continuing development of control technology.

3.1 Sulphur Dioxide (SO_2)

Background levels of sulphur dioxide in the atmosphere have been determined as 4 micrograms per cubic metre ($\mu g/m^3$) or less, and no current evidence indicates that these levels can cause harm to

the environment.[2] Levels well in excess of background concentrations can, however, have a deleterious effect on vegetation and human health.

The maximum tolerable levels are for evaluation purposes, to identify the severity of an anthropogenic or natural phenomenon in order to protect human health and institute appropriate corrective action.

The maximum acceptable levels have been determined on the basis of the following considerations:

Levels of less than 900 $\mu g/m^3$ (0.34 ppm) averaged for one hour will minimize discomfort to sensitive individuals, with respect to taste and odour.

Levels of less than 300 $\mu g/m^3$ (0.11 ppm) averaged over a 24 hour period will minimize health effects, while levels of less than 60 $\mu g/m^3$ (0.02 ppm) averaged over one year would avoid chronic effects to forested areas.

The maximum desirable levels have been justified on the basis of being at or below the threshold of very slight human effects and very slight chronic effects to forests.

TABLE 1 - AMBIENT AIR QUALITY CRITERIA

CONTAMINANT	AVERAGING PERIOD	MAX. TOLERABLE LEVEL	MAX. DESIRABLE LEVEL	MAX. ACCEPTABLE LEVEL
Sulphur Dioxide	1-hour		450 (0.17)	900 (0.34)
	24-hour	800 (.31)	150 (0.06)	300 (0.11)
	Annual		30 (0.01)	60 (0.02)

Concentrations are expressed in units of micrograms of contaminant per cubic meter ($\mu g/m^3$) of air corrected to standard conditions of 25°C and 101.3 kilopascals of pressure. The part per million - ppm - (by volume) equivalent concentrations are given in parentheses.

4. PROCEDURES

Monitoring for Sulphur Dioxide was performed using two instruments. A description of each analyzer follows.

4.1 Sulphur Dioxide Monitoring - Interscan

The Interscan 1240 Series sulphur dioxide analyzer, a hand-held model, employs a voltammetric sensor to electrochemically detect gas under diffusion controlled conditions. Gas molecules from the sample are adsorbed on an electrocatalytic sensing electrode, after passing through a diffusion medium, and are electrochemically reacted at an appropriate sensing electrode potential. This reaction generates an electric current directly proportional to the gas concentration. This current is converted to a voltage for recorder or meter readout.

4.2 Sulphur Dioxide Monitoring - Teco

The Thermo Electron Model 43 pulsed fluorescence analyzer is a continuous monitor for measurement of ambient SO_2 levels in the environment. Pulsating ultraviolet light is focused through a narrow bandpass filter into a fluorescence chamber. Sulphur dioxide molecules are excited to a higher energy state in the chamber giving off a decay radiation (light) characteristic for SO_2. This radiation is allowed to pass selectively through a second filter to impinge on a photomultiplier tube. The light emissions are processed electronically, such that the light energy is converted into a voltage signal which is proportional to the concentration of sulphur dioxide

in the sample being analyzed. This method is highly specific, with few interferences.

4.3 Wind Speed and Direction

Meteorological data was obtained from the Atmospheric Environment Service (AES) data base for the Winnipeg International Airport observation site, which is located approximately 3.5 km from the monitoring site. Information on wind conditions and various other meteorological parameters is reported (up-dated) hourly on the data base and the most recent hour's data can be accessed within a few minutes at approximately 5 minutes after the hour. Meteorological conditions associated with the sampling period are shown in Appendix A.

5. MONITORING SITES

Monitoring was conducted at three sites during the course of the survey. All locations were less than 0.5 km. from the Canada Metal plant.

A detailed site description of each location accompanies Map 1 in Appendix B.(3)

6. RESULTS

Hourly averaged concentrations for sulphur dioxide measured at each sampling site are shown in Table 2. Corresponding wind speed and direction measurements are also included. The average SO_2 concentrations were calculated visually from strip chart records. Meteorological information was obtained from the A.E.S. (Atmospheric Environment Service) Data base, compiled by the Prairie Weather Centre in Winnipeg (see Appendix A).

TABLE 2 - RESULTS

Date	Time	Site	SO_2 Conc. (ppm for 1 hr.*) Teco	Interscan	Wind speed (Knots)	Wind Direction (degrees from T.N.)
8-01-22	09:30-10:00	1				
	10:00-10:30		0.03	0.05	16	340
	10:30-10:50		Move to site #2			
	11:00-11:30	2				
	11:30-12:00		<0.01	0.01		
	12:00-12:30			<0.01	17	340
	12:30-13:00		<0.01	<0.01		
86-01-23	10:30-11:00	1				
	11:00-11:30		0.06	0.04	3	150 (var**)
	11:30-12:00			0.02		
	12:00-12:30		<0.01	<0.01	1	180 (var)
	12:30-13:00			0.02		
	13:00-13:30		0.04	0.08	2	360 (var)
	13:30-14:00			0.13		
	14:00-14:30		0.09	0.12	3	360 (var)
	14:30-15:00			0.05***		
	15:00-15:30		0.03	0.04***	calm	
	15:30-16:00			0.10		
	16:00-16:30		0.09	0.13	2	360 (var)
	16:30-17:00			0.11		
	17:00-17:30		0.10	0.10	3	180 (var)
	17:30-18:00		0.16	0.11		
	18:00-18:30		0.15	0.14	2	210 (var)
	18:30-19:00		0.16	0.22		
	19:00-19:30		0.20	0.31	2	190 (var)
	19:30-20:00		0.15	0.24		
	20:00-20:30		0.06	0.09	calm	
	20:30-21:00		0.05	0.04		
	21:00-21:30		0.09	0.08	2	190 (var)
	21:30-22:00		0.11	0.14		
	22:00-22:30		0.08	0.11	4	190 (var)
	22:30-23:00		0.05	0.04		
	23:00-23:30		0.06	0.06	4	170 (var)
	23:30-24:00			0.04		
86-01-24	00:00-00:30		<0.01	<0.01	3	160 (var)
	00:30-01:00		<0.01	<0.01		
	01:00-01:30			<0.01	calm	

TABLE 2 - RESULTS - (Continued)

Date	Time	Site	SO_2 Conc. (ppm for 1 hr.*) Teco	Interscan	Wind speed (Knots)	Wind Direction (degrees from T.N.)
86-01-24	01:30-02:00	1	<0.01	<0.01		
	02:00-02:30			0.02	calm	
	02:30-03:00		0.01	0.01		
	03:00-03:30			<0.01	2	140 (var)
	03:30-04:00		<0.01	<<0.01		
	04:00-04:30			<0.01	3	120 (var)
	04:30-05:00		<0.01	<0.01		
	05:00-05:30			<0.01	5	130
	05:30-06:00		<0.01	<0.01		
	06:00-06:30			<0.01	5	090
	06:30-07:00		<0.01	<0.01		
	07:00-07:30			<0.01	6	120
	07:30-08:00		<0.01	<0.01		
	08:00-08:30			<0.01	6	110
	08:30-09:00		<0.01	<0.01		

* 1 hr. averages refer to the designated plus previous 1/2 hr.

** Wind direction; variable (var) conditions are frequent at speeds equal to or less than 4 knots (2 metres/sec.)

*** the Interscan monitor was used at a different range setting (mid range) 0-2.5 ppm for 1 hour.

7. DISPERSION MODELLING

As in the first study[1] some dispersion modelling has been used to assist and supplement the environmental monitoring and assessment. The model used for this report is the "Plumes" model, provided by the Alberta Department of Environment.[4] This model offers greater precision and resolution than the "PNT1" model utilized previously.

The model was used to assess the sampling sites employed, indicating the downwind range at which maximum concentrations would occur, in the plane of monitoring. Input parameters for the stack height and diameter, gas exit velocity, and gas temperature were obtained from stack sampling performed previously.[5] Two sites were examined (Site #1 and Site A), with modelling results listed in printout format in Appendix C.

The first run was an assessment of Site A, where the hand held analyzer was used on the afternoon of January 21, 1986 (See Appendix B for a complete site description). The meteorological parameters used for model input are the actual conditions as they existed on the day of sampling.

The results of the first run indicate the area receiving the highest ground level concentration was estimated to be approximately 250 metres downwind of the plant. The sampling location was in fact about 125 metres away and as a result the levels that we noted would be approximately 75% of the predicted maximum.

The second run was essentially the same exercise performed for Site #1. Again the meteorological input parameters were taken from actual conditions at the time of maximum monitored ambient levels, which occured on the evening of January 23, 1986 (please see Appendix A).

On this occasion (2nd run) the model predicted that maximum levels at 5 metres height would occur approximately 550 metres downwind on the plume centre line. The monitoring location was approximately 200 metres downwind and therefore the amounts we measured were only about 20% of the predicted maximum.

The actual monitored levels which we recorded during the survey were significantly greater than the levels predicted by the model when the measured emission levels were used as the stack input parameters. The next step, therefore, was to use the actual monitored ambient levels to generate a revised estimate for emission levels. For this determination we again used the Thursday evening conditions.

The third model run demonstrates that the emission rate necessary to allow for a downwind concentration at 200 meters of 0.20 ppm would be approximately 9.4 times greater than the levels measured during the stack sampling survey.

Finally, using the same model run (3rd) the estimated maximum ambient concentration at the time of monitoring can be shown.

From the third run the estimated maximum concentration of SO_2 is approximately 0.98 ppm for 1 hour. This level, while only a prediction, is almost 3 times greater than the hourly air quality objective for SO_2 which is 0.34 ppm.

8. OBSERVATIONS AND COMMENTS

On Tuesday afternoon (Jan. 21) the monitoring results from the Interscan analyzer, as read visually indicated that levels were regularly peaking at greater than 1 ppm concentrations. Instrument adjustments revealed that occasionally readings were off-scale on the high range of 0 - 5 ppm. During a one hour period between 13:00 - 14:00 there were at least 13 peaks off scale at the low range setting of 0 - 1 ppm. Each incident of this nature lasted for about 30 seconds to one minute. Model run number 1 suggests that levels at the monitoring site would be approximately 60% of the predicted maximum. Thus, it seems highly probable that in some areas transient levels may have exceeded 5 - 10 ppm. It should be noted that with these transient conditions, if levels in excess of 10 ppm. occur for even 2 minutes during an hour, the MAL (0.34 ppm) would be exceeded. Therefore, it seems likely that the hourly objective was in fact exceeded under these conditions.

For model runs 2 and 3 the calculation plane was adjusted to 5 metres height, to represent the sample intake manifold of the MMU. In run number one the calculation plane was 0 metres, ground level.

The dispersion model estimates indicated that, with the meteorological conditions existent at the time of monitoring, maximum ground level concentrations would have occurred at a location farther downwind from where the MMU was sampling. Based upon the MMU measured one-hour maximum, the model predicted the highest one hour level at the optimum site to be 0.98 ppm. This is almost three times the one-hour MAL (0.34 ppm).

The ratio of the actual measured maximum concentration (0.20 ppm) and the predicted maximum (0.98 ppm) indicates that when a level in excess of 0.07 ppm was measured at site number 1, there was a strong possibility that the objective (0.34 ppm) was exceeded farther downwind. One-hour levels greater than 0.07 ppm occurred on 11 separate occasions.

9. CONCLUSIONS

1) The investigations carried out by the MMU confirmed that the source of the odourous emissions, which led to the complaint calls, were sulphur dioxide emissions from Canada Metal Co. Ltd. at 1221 St. James Street.

2) Monitoring revealed elevated levels of SO_2. Hourly averaged sulphur dioxide concentrations, though not exceeding the Maximum Acceptable Level (MAL) of 0.34 ppm, did exceed the Maximum Desirable Level (MDL) of 0.17 ppm 3 times. During some periods of one minute duration or so, instantaneous levels as high as 2-5 ppm were recorded. Variable winds appeared to have a far greater effect on suppressing ambient levels than did any apparent reductions in emission levels.

3) Modelling estimates indicate that the one-hour MAL (0.34 ppm) was probably exceeded in locations other than those monitored. Predictions are that this may have occurred a minimum 11 times.

10. REFERENCES

1) Szkolnicki, M., 1984. Ambient Sulphur Dioxide levels in the vicinity of Canada Metal Co. Ltd., Winnipeg, Manitoba. Department of Environment and Workplace Safety and Health, Air Standards and Studies Report No. 85-5, pp. 23.

2) Georgi, H. W. 1970 Journal of Geophysical Resources, Volume 75, 2365-2371 as cited in "Review of National Ambient Air Quality Objectives for Sulphur Dioxide". 1982, Subcommittee on National Air Quality Objectives.

3) Map for this study obtained from:
City of Winnipeg Planning Office.

4) Alberta Environment, 1980. Guidelines for Plume Dispersion Calculations, 2nd printing. Standards and Approvals Division, pp. 112.

5) Reeve, K. E. 1982. Source Emission Testing for Sulphur Dioxide and Sulphuric Acid Mist at Canada Metal Co. Ltd., Winnipeg, Manitoba. Environmental Management Division, Environmental Control Services.

Appendix A

Sample Atmospheric Environment Service (A.E.S.) Output

Station = YWG FROM 1500Z to 1400Z JANUARY 24, 1986 1410Z

HZ	n1HmhM	VISB	WW	PPP	TT	TD	DDVV	P06H	P24H	SNDP	APPP	MX/MN
15	655708	15		320	-16	-20	1104				+ 1	/
16	255718	15		318	-16	-20	0805					/
17	255718	15		315	-14	-19	1108				- 9	/
18	309778	15		303	-14	-19	0909	TR		8	- 17	-13.5/-18.8
19	209718	15		293	-13	-18	1010				- 26	/
20	209718	15		286	-12	-18	1010				- 26	/
21	60/718	15		271	-11	-17	1012				- 29	/
22	809708	15		264	-10	-16	0910				- 26	/
23	809708	15		259	-10	-16	1012				- 23	/
00	8097-8	15		252	-10	-16	1011				- 19	-10.0/-18.0
01	809708	15		239	-10	-16	1014				- 23	/
02	855008	15		232	-10	-16	1015				- 29	/
03	856008	15		218	-10	-16	1016				- 31	/
04	856008	15		212	-10	-16	1014				- 26	/
05	854008	15	S-	202	-9	-15	1013				- 26	/
06	90-009	3	S-	191	-9	-13	1114	TR		8	- 27	/
07	-0-009	3/4	S-	177	-9	-11	1014				- 36	/
08	-0-009	11/4	S-	173	-9	-11	1013				- 29	/
09	-0-009	11/4	S-	151	-9	-10	1012				- 35	/
10	855008	15		141	-8	-10	1012				- 29	/
11	855008	21/2	S-	130	-8	-10	1011				- 36	/
12	855008	21/2	S-	123	-7	-9	1010	30	28	8	- 28	/
13	855008	21/2	S-	115	-7	-8	1011				- 26	/
14	855002	3	S-	105	-7	-8	1111				- 26	/

Hz	n1HmhN	VISB	WW	PPP	TT	TD	DDVV	P06H	P24H	SNDP	APPP	MX/MN

Heading	Description	Units
Hz	Hour of report	GMT
n	Total of low and mid clouds	Octats
l	Type of low clouds	Synoptic Code
H	Height of lowest cloud	Synoptic Code
h	Type of high cloud	Synoptic Code
VISB	Visibility	Miles (may be in fractions)
WW	Present Weather	Synoptic weather in SA
PPP	Station pressure	mB as per SA format
TT	Air temperature	degrees Celsius
TD	Dew Point Temperature	degrees Celsius
DDVV	Wind direction and speed	Tens of degrees and knots
P06H	Precipitation of last 6 hours	mm*10
P24H	Precipitation of last 24 hours	mm*10
SNDP	Snow Depth	cm
APPP	Pressure change and tendency	mb*10
MX / MN	Maximum and minimum temperature	degrees Celsius

A dash (-) for any value means that this value is unavailable

Appendix B

Description of Monitoring Sites

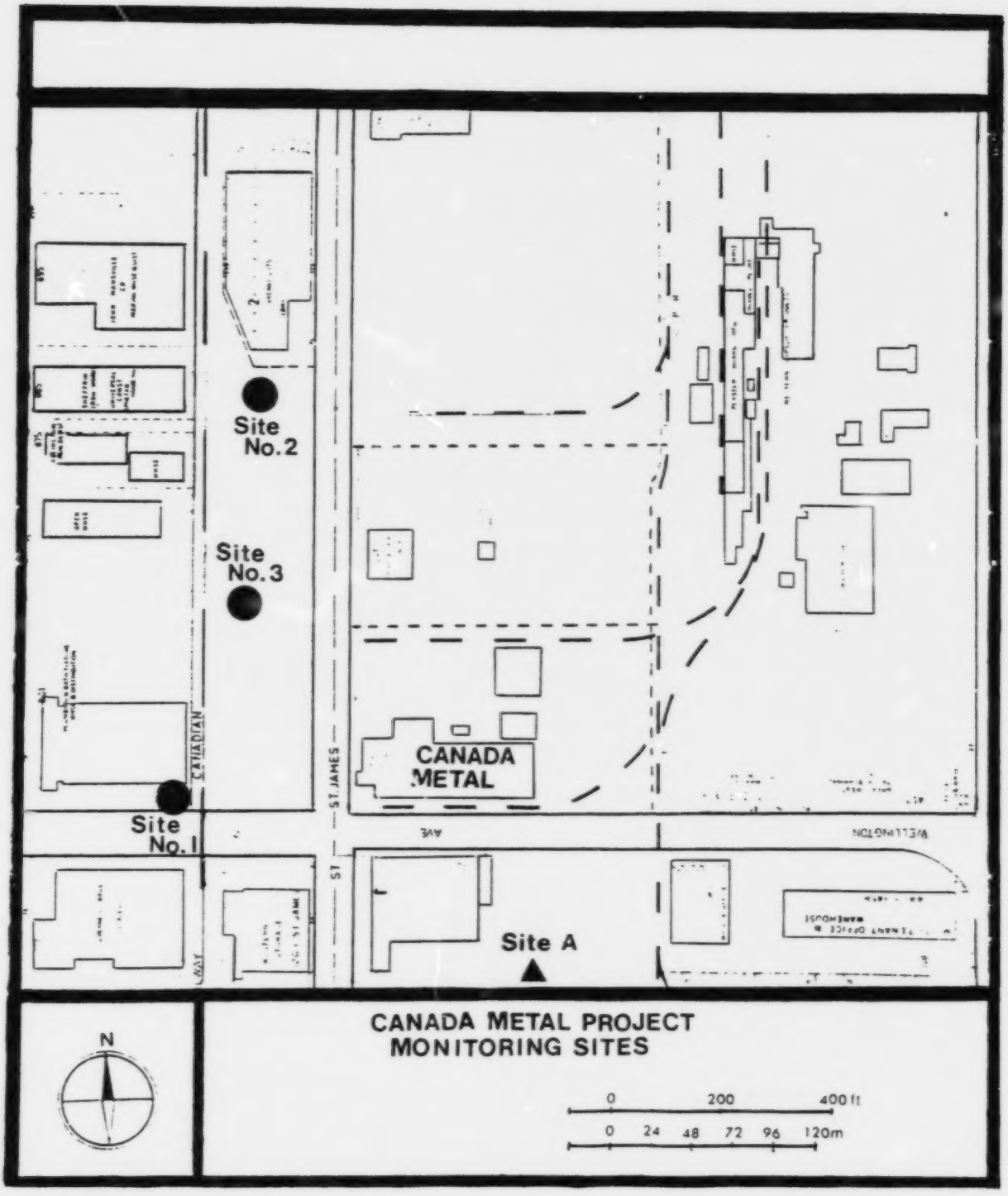
Appendix B - Description of Monitoring Sites

Monitoring Site A - Located in the field directly south, approximately 130 metres, of the Canada Metal Co. stack.
Bearing to stack = 0° (due north)
Distance to stack = approximately 125 metres

Monitoring Site 1 - Located west of Canada Metal, just north of Wellington, west of the railway tracks. In the parking lot of Westbourne Ltd.
Bearing to stack = 90°
Distance to stack = approximately 220 metres

Monitoring Site 2 - Located north-north west of Canada Metal Co., in the rail lot west of St. James Street. Just south of the Wosk's warehouse.
Bearing to stack = 70°
Distance to stack = approximately 270 metres.

Monitoring Site 3 - Located north-west of Canada Metal Co., in the rail lot west of St. James Street, south of Site 2.
Bearing to stack = 125°
Distance to stack = approximately 185 metres.


Site No.2
Site No.3
Site No.1
CANADA METAL
ST. JAMES
CANADIAN
Site A
N
CANADA METAL PROJECT
MONITORING SITES
0 200 400 ft
0 24 48 72 96 120m

Appendix C

Dispersion Modelling Runs

This is a test input file for Can. Metals disp. mod. vers. 1.0

WIND SPEED =	5.	M/S
WIND DIRECTION =	346.	DEGREES FROM TRUE NORTH
ANEMOMETER HEIGHT =	10.	M
AMBIENT TEMPERATURE =	-13.	C

FLAT TERRAIN
ROUGHNESS = 100 CM

UNLIMITED MIXING

PASQUILL STABILITY CATEGORY D /NEUTRAL

DOWNWIND DISTANCES

MAXIMUM =	300.	M
MINIMUM =	0.	M
INCREMENT =	25.	M

CROSSWIND DISTANCES

MAXIMUM =	100.	M
MINIMUM =	-100.	M
INCREMENT =	20.	M

NUMBER OF STACKS = 1

* PARAMETERS FOR STACK 1

STACK HEIGHT =	20.	M
STACK DIAMETER =	1.04	M
STACK DISTANCE =	0.	M FROM ORIGIN
STACK ANGLE =	0.	DEGREES FROM TRUE NORTH
GAS VELOCITY =	8.	M/S
GAS TEMPERATURE =	90.	C
EMISSION RATE =	.011100	***G/S AT 101.325 KPA AND REFERENCE TEMPERATURE
REFERENCE TEMPERATURE =	25.0	C
X RELATIVE =	0.	M
Y RELATIVE =	0.	M

***** STACK AERODYNAMIC DOWNWASH OCCURS UNDER THE SPECIFIED ATMOSPHERIC CONDITIONS *****

CUMULATIVE POLLUTANT CONCENTRATION IN PPM AS A 1.00 HOUR AVERAGE AT A HEIGHT OF 0. M ABOVE THE GROUND

CROSSWIND DISTANCE (M)	DOWNWIND DISTANCE IN METERS												
	0	25	50	75	100	125	150	175	200	225	250	275	300
100	.000	.000	.000	.000	.000	.000	.000	.001	.002	.007	.012	.017	.022
80	.000	.000	.000	.000	.000	.000	.002	.006	.011	.021	.029	.036	.042
60	.000	.000	.000	.000	.001	.004	.011	.022	.035	.047	.057	.065	.070
40	.000	.000	.000	.001	.008	.021	.036	.056	.072	.085	.093	.098	.101
20	.000	.000	.001	.014	.037	.057	.075	.097	.112	.121	.125	.126	.124
0	.000	.000	.006	.031	.060	.080	.096	.117	.129	.136	.138	.137	.134
-20	.000	.000	.001	.014	.037	.057	.075	.097	.112	.121	.125	.126	.124
-40	.000	.000	.000	.001	.008	.021	.036	.056	.072	.085	.093	.098	.101
-60	.000	.000	.000	.000	.001	.004	.011	.022	.035	.047	.057	.065	.070
-80	.000	.000	.000	.000	.000	.000	.002	.006	.011	.021	.029	.036	.042
-100	.000	.000	.000	.000	.000	.000	.000	.001	.002	.007	.012	.017	.022

MAXIMUM CONCENTRATION IN THE ABOVE TABLE IS .138 PPM AND OCCURS AT (250 , 0)

STACK	EFFECTIVE STACK HEIGHTS IN METRES AT ABOVE DOWNWIND DISTANCES										
1*********	23.	24.	26.	27.	29.	30.	30.	30.	30.	30.	30.

This is a test input file for Can. Metal disp. mod vers. 2.0

```
        WIND SPEED =      2.  M/S
    WIND DIRECTION =    105.  DEGREES FROM TRUE NORTH
  ANEMOMETER HEIGHT =    10.  M

AMBIENT TEMPERATURE =   -10.  C

FLAT TERRAIN
ROUGHNESS = 100 CM

UNLIMITED MIXING

PASQUILL STABILITY CATEGORY D (NEUTRAL

DOWNWIND DISTANCES
          MAXIMUM =    600.  M
          MINIMUM =      0.  M
        INCREMENT =     50.  M

CROSSWIND DISTANCES
          MAXIMUM =    100.  M
          MINIMUM =   -100.  M
        INCREMENT =     20.  M


   NUMBER OF STACKS =    1


PARAMETERS FOR STACK  1

         STACK HEIGHT =     20.  M
       STACK DIAMETER =   1.04  M
       STACK DISTANCE =      0.  M  FROM ORIGIN
          STACK ANGLE =      0.  DEGREES FROM TRUE NORTH
         GAS VELOCITY =      8.  M/S
      GAS TEMPERATURE =     80.  C
       EMISSION RATE = .011100  ***G/S AT 101.325 KPA AND REFERENCE TEMPERATURE
 REFERENCE TEMPERATURE =    25.0  C
          X RELATIVE =      0.  M
          Y RELATIVE =      0.  M
```

CUMULATIVE POLLUTANT CONCENTRATION IN PPM AS A 1.00 HOUR AVERAGE AT A HEIGHT OF 5. M ABOVE THE GROUND

CROSSWIND DISTANCE (M)	DOWNWIND DISTANCE IN METERS												
	0	50	100	150	200	250	300	350	400	450	500	550	600
100	.000	.000	.000	.000	.001	.004	.011	.021	.032	.042	.050	.057	.061
80	.000	.000	.000	.000	.002	.009	.021	.034	.047	.057	.065	.071	.074
60	.000	.000	.000	.001	.006	.018	.034	.050	.064	.072	.080	.084	.086
40	.000	.000	.000	.002	.012	.030	.049	.066	.079	.087	.092	.095	.095
20	.000	.000	.001	.004	.018	.040	.061	.079	.090	.097	.101	.102	.101
0	.000	.000	.002	.005	.021	.044	.065	.082	.093	.100	.104	.105	.104
-20	.000	.000	.001	.004	.018	.040	.061	.079	.090	.097	.101	.102	.101
-40	.000	.000	.000	.002	.012	.030	.049	.066	.079	.087	.092	.095	.095
-60	.000	.000	.000	.001	.006	.018	.034	.050	.064	.072	.080	.084	.086
-80	.000	.000	.000	.000	.002	.009	.021	.034	.047	.057	.065	.071	.074
-100	.000	.000	.000	.000	.001	.004	.011	.021	.032	.042	.050	.057	.061

MAXIMUM CONCENTRATION IN THE ABOVE TABLE IS .105 PPM AND OCCURS AT : 550 , 0 :

STACK	EFFECTIVE STACK HEIGHTS IN METRES AT ABOVE DOWNWIND DISTANCES										
1*********	76.	45.	51.	51.	51.	51.	51.	51.	51.	51.	51.

A

This is a test input file for Can. Metal disp. mod vers. 3.0

WIND SPEED =	2.	M/S
WIND DIRECTION =	105.	DEGREES FROM TRUE NORTH
ANEMOMETER HEIGHT =	10.	M
AMBIENT TEMPERATURE =	-10.	C

FLAT TERRAIN
ROUGHNESS = .100 CM

UNLIMITED MIXING

PASQUILL STABILITY CATEGORY D /NEUTRAL

DOWNWIND DISTANCES

MAXIMUM =	600.	M
MINIMUM =	0.	M
INCREMENT =	50.	M

CROSSWIND DISTANCES

MAXIMUM =	100.	M
MINIMUM =	-100.	M
INCREMENT =	20.	M

NUMBER OF STACKS = 1

PARAMETERS FOR STACK 1

STACK HEIGHT =	20.	M
STACK DIAMETER =	1.04	M
STACK DISTANCE =	0.	M FROM ORIGIN
STACK ANGLE =	0.	DEGREES FROM TRUE NORTH
GAS VELOCITY =	8.	M/S
GAS TEMPERATURE =	80.	C
EMISSION RATE =	.104300	G**3/S AT 101.325 KPA AND REFERENCE TEMPERATURE
REFERENCE TEMPERATURE =	25.0	C
X RELATIVE =	0.	M
Y RELATIVE =	0.	M

CUMULATIVE POLLUTANT CONCENTRATION IN PPM AS A 1.00 HOUR AVERAGE AT A HEIGHT OF 5. M ABOVE THE GROUND

CROSSWIND DISTANCE (M)	DOWNWIND DISTANCE IN METERS												
	0	50	100	150	200	250	300	350	400	450	500	550	600
100	.000	.000	.000	.000	.005	.035	.104	.199	.301	.394	.473	.537	.587
80	.000	.000	.000	.001	.009	.062	.167	.324	.442	.540	.615	.669	.698
60	.000	.000	.000	.005	.054	.171	.324	.473	.597	.688	.751	.788	.806
40	.000	.000	.002	.018	.112	.279	.462	.621	.740	.820	.868	.890	.895
20	.000	.000	.010	.037	.178	.374	.572	.751	.842	.910	.946	.958	.960
0	.000	.001	.016	.047	.200	.412	.614	.771	.879	.940	.974	.982	.982
-20	.000	.000	.010	.037	.178	.374	.572	.751	.842	.910	.946	.958	.960
-40	.000	.000	.002	.018	.112	.279	.462	.621	.740	.820	.868	.890	.895
-60	.000	.000	.000	.005	.054	.171	.324	.473	.597	.688	.751	.788	.806
-80	.000	.000	.000	.001	.020	.086	.167	.324	.442	.540	.615	.669	.698
-100	.000	.000	.000	.000	.005	.035	.104	.199	.301	.394	.473	.537	.587

MAXIMUM CONCENTRATION IN THE ABOVE TABLE IS .982 PPM AND OCCURS AT (550 , 0)

STACK	EFFECTIVE STACK HEIGHTS IN METRES AT ABOVE DOWNWIND DISTANCES											
1**********	38.	45.	51.	51.	51.	51.	51.	51.	51.	51.	51.	51.

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